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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
MARTINEZ, BRITTANY M	

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1793	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/526,941	YODH ET AL.	
	Examiner	Art Unit	
	BRITTANY M. MARTINEZ	1793	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *25 January 2010*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-139* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-139* is/are rejected.

7)☒ Claim(s) *20, 45, 49, 74, 96, 99, 102, 136 and 137* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicants' submission filed on January 25, 2010, has been entered.

Status of Application

Applicants' arguments/remarks and amendments filed January 25, 2010, have been carefully considered. **Claims 1-139** are pending in the instant application and have been examined.

Claim Objections

2. **Claims 20, 45, 49, 74, 96, 99, 102, 136 and 137** are objected to because of the following informalities: In **Claim 20**, "mg/mi" should be changed to "mg/ml;" in **Claim 45**, "mg/mi" should be changed to "mg/ml;" in **Claim 49**, it appears as if "500 mm" should be "500 nm;" **Claim 74** must end with a period; **Claim 96** must end with a period; in **Claim 99**, it appears as if "500 urn" should be "500 nm;" in **Claim 102**, "comprise" should be "comprises;" in **Claim 136**, "mg/mi" should be changed to "mg/ml;" and in

Claim 137, "endon-end" should be changed to "end-on-end." Appropriate correction is required.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. **Claims 98 and 99** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention.

5. **Claim 98** recites the limitation "The method of claim 26." There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.

4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

8. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

9. **Claims 1-13, 15-18, 55-60, and 139** are rejected under 35 U.S.C. 103(a) as obvious over Rohrbaugh et al. (US 2002/0028288 A1).

10. With regard to **Claims 1-13 and 15-18**, Rohrbaugh discloses a dispersion comprising an aqueous medium; nanotubes; and a surfactant comprising sodium dodecylbenzene sulfonate (Rohrbaugh, Abstract, 0044-0046; 0073-0130; 0141). The difference between the dispersion of Rohrbaugh and that of **Claim 1** is Rohrbaugh discloses nanotubes, but not carbon nanotubes. However, it is well-known in the art that carbon nanotubes are a type of nanotube and thus, carbon nanotubes are an obvious variant of nanotubes. Thus, it would have been obvious to one of ordinary skill in the art to try to modify the dispersion disclosed by Rohrbaugh with carbon nanotubes because one of ordinary skill in the art could have pursued the known potential nanotube options within his or her technical grasp with a reasonable expectation of success.

11. While Rohrbaugh does not explicitly disclose the surfactant capable of non-covalently adhering to said carbon nanotubes **(Claim 3)**; nor the aromatic group being capable of π–like stacking onto the surface of carbon nanotubes **(Claim 9)**, these claimed limitations would be inherent. For a reference which neither expressly describes or teaches the subject matter alleged to be anticipated, the reference must provide enough information to permit an inference that the subject matter is inherent. *Ex parte Garvin*, 62 USPQ 2d 1680 (BPAI 2001). The surfactant of Rohrbaugh would inherently be capable of non-covalently adhering to said carbon nanotubes, and the aromatic group would inherently be capable of π–like stacking onto the surface of carbon nanotubes to no less an extent than that of the instant application since Rohrbaugh discloses the same dispersion as that of the instant application. Accordingly, the burden shifts to Applicants to show that non-covalent adhesion and π–like stacking would not occur in the dispersion of Rohrbaugh.

12. With regard to **Claims 55-57**, Rohrbaugh discloses a composition comprising nanotubes; and a surfactant comprising sodium dodecylbenzene sulfonate (Rohrbaugh, Abstract, 0044-0046; 0073-0130; 0141). Rohrbaugh further discloses that the composition may be in the form of a powder, film, or particle (Rohrbaugh, Abstract; Figures; 0073). The difference between the composition of Rohrbaugh and that of **Claim 55** is Rohrbaugh discloses nanotubes, but not carbon nanotubes. However, it is well-known in the art that carbon nanotubes are a type of nanotube and thus, carbon nanotubes are an obvious variant of nanotubes. Thus, it would have been obvious to one of ordinary skill in the art to try to modify the composition disclosed by Rohrbaugh

with carbon nanotubes because one of ordinary skill in the art could have pursued the known potential nanotube options within his or her technical grasp with a reasonable expectation of success.

13. While Rohrbaugh does not explicitly disclose the surfactant being adsorbed to the exterior surface of said carbon nanotubes (**Claim 56**), this limitation would be inherent. For a reference which neither expressly describes or teaches the subject matter alleged to be anticipated, the reference must provide enough information to permit an inference that the subject matter is inherent. *Ex parte Garvin*, 62 USPQ 2d 1680 (BPAI 2001). The surfactant of Rohrbaugh would inherently be adsorbed to the exterior surface of said carbon nanotubes to no less an extent than that of the instant application since Rohrbaugh discloses the same composition as that of the instant application. Accordingly, the burden shifts to Applicants to show that adsorption to the exterior surface of said carbon nanotubes would not occur in the composition of Rohrbaugh.

14. With regard to **Claims 58-60**, Rohrbaugh discloses a composite comprising a polymer; and nanotubes and a surfactant comprising sodium dodecylbenzene sulfonate dispersed within the polymer (Rohrbaugh, Abstract, 0044-0046; 0073-0130; 0141). Rohrbaugh further discloses that the composition may be in the form of a powder, film, or particle (Rohrbaugh, Abstract; Figures; 0073). The difference between the composite of Rohrbaugh and that of **Claim 58** is Rohrbaugh discloses nanotubes, but not carbon nanotubes. However, it is well-known in the art that carbon nanotubes are a type of nanotube and thus, carbon nanotubes are an obvious variant of nanotubes. Thus, it

would have been obvious to one of ordinary skill in the art to try to modify the composite disclosed by Rohrbaugh with carbon nanotubes because one of ordinary skill in the art could have pursued the known potential nanotube options within his or her technical grasp with a reasonable expectation of success.

15. With regard to **Claim 139**, Rohrbaugh discloses a composition comprising nanotubes, gel precursor, and surfactant, said surfactant comprising sodium dodecylbenzene sulfonate (Rohrbaugh, Abstract, 0044-0046; 0070; 0073-0130; 0141). The difference between the composition of Rohrbaugh and that of **Claim 139** is Rohrbaugh discloses nanotubes, but not carbon nanotubes. However, it is well-known in the art that carbon nanotubes are a type of nanotube and thus, carbon nanotubes are an obvious variant of nanotubes. Thus, it would have been obvious to one of ordinary skill in the art to try to modify the composition disclosed by Rohrbaugh with carbon nanotubes because one of ordinary skill in the art could have pursued the known potential nanotube options within his or her technical grasp with a reasonable expectation of success.

1. **Claims 1-13, 15-18 and 55-57** are rejected under 35 U.S.C. 103(a) as being unpatentable over Chiang (US 5,648,523).

2. With regard to **Claims 1-13 and 15-18**, Chiang discloses a dispersion comprising an aqueous medium; fullerenes; and a surfactant comprising sodium dodecylbenzene sulfonate (Chiang, c. 10, Example 2). The difference between the dispersion of Chiang and that of **Claim 1** is Chiang discloses fullerenes instead of carbon nanotubes.

However, it is well-known in the art that carbon nanotubes are a type of fullerene and thus, carbon nanotubes are an obvious variant of fullerenes. Thus, it would have been obvious to one of ordinary skill in the art to try to modify the dispersion disclosed by Chiang with carbon nanotubes because one of ordinary skill in the art could have pursued the known potential fullerene options within his or her technical grasp with a reasonable expectation of success.

3. While Chiang does not explicitly disclose the surfactant being capable of non-covalently adhering to said carbon nanotubes (**Claim 3**); nor the aromatic group being capable of π–like stacking onto the surface of carbon nanotubes (**Claim 9**), these claimed limitations would be inherent. For a reference which neither expressly describes or teaches the subject matter alleged to be anticipated, the reference must provide enough information to permit an inference that the subject matter is inherent. *Ex parte Garvin*, 62 USPQ 2d 1680 (BPAI 2001). The surfactant of Chiang would inherently be capable of non-covalently adhering to said carbon nanotubes, and the aromatic group would inherently be capable of π–like stacking onto the surface of carbon nanotubes to no less an extent than that of the instant application since Chiang discloses the same dispersion as that of the instant application. Accordingly, the burden shifts to Applicants to show that non-covalent adhesion and π–like stacking would not occur in the dispersion of Chiang.

4. With regard to **Claims 55-57**, Chiang discloses a composition comprising fullerenes; and a surfactant comprising sodium dodecylbenzene sulfonate (Chiang, c. 10, Example 2). Chiang further disclose the composition in the form of a particle

(Chiang, c. 10, Example 2). The difference between the composition of Chiang and that of **Claim 55** is Chiang discloses fullerenes instead of carbon nanotubes. However, it is well-known in the art that carbon nanotubes are a type of fullerene and thus, carbon nanotubes are an obvious variant of fullerenes. Thus, it would have been obvious to one of ordinary skill in the art to try to modify the composition disclosed by Chiang with carbon nanotubes because one of ordinary skill in the art could have pursued the known potential fullerene options within his or her technical grasp with a reasonable expectation of success.

5. While Chiang does not explicitly disclose the surfactant being adsorbed to the exterior surface of said carbon nanotubes **(Claim 56)**, this limitation would be inherent. For a reference which neither expressly describes or teaches the subject matter alleged to be anticipated, the reference must provide enough information to permit an inference that the subject matter is inherent. *Ex parte Garvin*, 62 USPQ 2d 1680 (BPAI 2001). The surfactant of Chiang would inherently be adsorbed to the exterior surface of said carbon nanotubes to no less an extent than that of the instant application since Chiang discloses the same composition as that of the instant application. Accordingly, the burden shifts to Applicants to show that adsorption to the exterior surface of said carbon nanotubes would not occur in the composition of Chiang.

16. **Claims 1-13, 15-18, 55-60, and 139** are rejected under 35 U.S.C. 103(a) as obvious over Lobovsky et al. (US 2002/0113335 A1) in view of Rohrbaugh et al. (US 2002/0028288 A1).

17. With regard to **Claims 1-13 and 15-18**, Lobovsky discloses a dispersion of carbon nanotubes comprising an aqueous medium, carbon nanotubes, and a surfactant comprising a sodium alkyl sulphate with an alkyl group having from 8 to 30 carbon atoms, such as sodium dodecyl sulphate (Lobovsky, p. 3, 0024; p. 4, 0042; p. 5, 0050; "Example 1;" and Fig. 3). The difference between the dispersion of Lobovsky and that of **Claims 1-13 and 15-18** is Lobovsky does not disclose the claimed surfactant.

6. With regard to **Claims 1-13 and 15-18**, Rohrbaugh discloses a dispersion comprising an aqueous medium; nanotubes; and a surfactant comprising sodium dodecylbenzene sulfonate (Rohrbaugh, Abstract, 0044-0046; 0073-0130; 0141). Thus, it would have been obvious to one of ordinary skill in the art to try to modify the dispersion disclosed by Lobovsky with the sodium dodecylbenzene sulfonate of Rohrbaugh because one of ordinary skill in the art could have pursued the known potential surfactant options within his or her technical grasp with a reasonable expectation of success.

18. While the aforementioned applied art does not explicitly disclose the surfactant capable of non-covalently adhering to said carbon nanotubes (**Claim 3**); nor the aromatic group being capable of π–like stacking onto the surface of carbon nanotubes (**Claim 9**), these claimed limitations would be inherent. For a reference which neither expressly describes or teaches the subject matter alleged to be anticipated, the reference must provide enough information to permit an inference that the subject matter is inherent. *Ex parte Garvin*, 62 USPQ 2d 1680 (BPAI 2001). The surfactant of Rohrbaugh would inherently be capable of non-covalently adhering to said carbon

nanotubes, and the aromatic group would inherently be capable of π–like stacking onto the surface of carbon nanotubes to no less an extent than that of the instant application since Rohrbaugh discloses the same dispersion as that of the instant application. Accordingly, the burden shifts to Applicants to show that non-covalent adhesion and π–like stacking would not occur in the dispersion of Rohrbaugh.

7. With regard to **Claims 55-57**, Lobovsky discloses a composition of carbon nanotubes comprising an aqueous medium, carbon nanotubes, and a surfactant comprising a sodium alkyl sulphate with an alkyl group having from 8 to 30 carbon atoms, such as sodium dodecyl sulphate (Lobovsky, p. 3, 0024; p. 4, 0042; p. 5, 0050; "Example 1;" and Fig. 3). The difference between the composition of Lobovsky and that of **Claims 55-57** is Lobovsky does not disclose the claimed surfactant.

8. With regard to **Claims 55-57**, Rohrbaugh discloses a composition comprising nanotubes; and a surfactant comprising sodium dodecylbenzene sulfonate (Rohrbaugh, Abstract, 0044-0046; 0073-0130; 0141). Rohrbaugh further discloses that the composition may be in the form of a powder, film, or particle (Rohrbaugh, Abstract; Figures; 0073). Thus, it would have been obvious to one of ordinary skill in the art to try to modify the composition disclosed by Lobovsky with the sodium dodecylbenzene sulfonate of Rohrbaugh because one of ordinary skill in the art could have pursued the known potential surfactant options within his or her technical grasp with a reasonable expectation of success.

19. While the aforementioned applied art does not explicitly disclose the surfactant being adsorbed to the exterior surface of said carbon nanotubes (**Claim 56**), this

limitation would be inherent. For a reference which neither expressly describes or teaches the subject matter alleged to be anticipated, the reference must provide enough information to permit an inference that the subject matter is inherent. *Ex parte Garvin*, 62 USPQ 2d 1680 (BPAI 2001). The surfactant of Rohrbaugh would inherently be adsorbed to the exterior surface of said carbon nanotubes to no less an extent than that of the instant application since Rohrbaugh discloses the same composition as that of the instant application. Accordingly, the burden shifts to Applicants to show that adsorption to the exterior surface of said carbon nanotubes would not occur in the composition of Rohrbaugh.

20. With regard to **Claims 58-60**, Lobovsky discloses a composite of carbon nanotubes comprising an aqueous medium, carbon nanotubes, and a surfactant comprising a sodium alkyl sulphate with an alkyl group having from 8 to 30 carbon atoms, such as sodium dodecyl sulphate (Lobovsky, p. 3, 0024; p. 4, 0042; p. 5, 0050; "Example 1;" and Fig. 3). The difference between the composite of Lobovsky and that of **Claims 58-60** is Lobovsky does not disclose the claimed surfactant.

21. With regard to **Claims 58-60**, Rohrbaugh discloses a composite comprising a polymer; and nanotubes and a surfactant comprising sodium dodecylbenzene sulfonate dispersed within the polymer (Rohrbaugh, Abstract, 0044-0046; 0073-0130; 0141). Rohrbaugh further discloses that the composition may be in the form of a powder, film, or particle (Rohrbaugh, Abstract; Figures; 0073). Thus, it would have been obvious to one of ordinary skill in the art to try to modify the composite disclosed by Lobovsky with the sodium dodecylbenzene sulfonate of Rohrbaugh because one of ordinary skill in the

art could have pursued the known potential surfactant options within his or her technical grasp with a reasonable expectation of success.

22. With regard to **Claim 139**, Lobovsky discloses a composition of carbon nanotubes comprising an aqueous medium, carbon nanotubes, and a surfactant comprising a sodium alkyl sulphate with an alkyl group having from 8 to 30 carbon atoms, such as sodium dodecyl sulphate (Lobovsky, p. 3, 0024; p. 4, 0042; p. 5, 0050; "Example 1;" and Fig. 3). The difference between the composition of Lobovsky and that of **Claim 139** is Lobovsky does not disclose the claimed surfactant.

23. With regard to **Claim 139**, Rohrbaugh discloses a composition comprising nanotubes, gel precursor, and surfactant, said surfactant comprising sodium dodecylbenzene sulfonate (Rohrbaugh, Abstract, 0044-0046; 0070; 0073-0130; 0141). Thus, it would have been obvious to one of ordinary skill in the art to try to modify the composition disclosed by Lobovsky with the sodium dodecylbenzene sulfonate of Rohrbaugh because one of ordinary skill in the art could have pursued the known potential surfactant options within his or her technical grasp with a reasonable expectation of success.

9. **Claims 1-13, 15-18 and 55-57** are rejected under 35 U.S.C. 103(a) as being unpatentable over Lobovsky et al. (US 2002/0113335 A1) in view of Chiang (US 5,648,523).

10. With regard to **Claims 1-13 and 15-18**, Lobovsky discloses a dispersion of carbon nanotubes comprising an aqueous medium, carbon nanotubes, and a surfactant

comprising a sodium alkyl sulphate with an alkyl group having from 8 to 30 carbon atoms, such as sodium dodecyl sulphate (Lobovsky, p. 3, 0024; p. 4, 0042; p. 5, 0050; "Example 1;" and Fig. 3). The difference between the dispersion of Lobovsky and that of **Claims 1-13 and 15-18** is Lobovsky does not disclose the claimed surfactant.

11. With regard to **Claims 1-13 and 15-18**, Chiang discloses a dispersion comprising an aqueous medium; fullerenes; and a surfactant comprising sodium dodecylbenzene sulfonate (Chiang, c. 10, Example 2). Thus, it would have been obvious to one of ordinary skill in the art to try to modify the dispersion disclosed by Lobovsky with the sodium dodecylbenzene sulfonate of Chiang because one of ordinary skill in the art could have pursued the known potential surfactant options within his or her technical grasp with a reasonable expectation of success.

12. While the aforementioned applied art does not explicitly disclose the surfactant being capable of non-covalently adhering to said carbon nanotubes (**Claim 3**); nor the aromatic group being capable of π–like stacking onto the surface of carbon nanotubes (**Claim 9**), these claimed limitations would be inherent. For a reference which neither expressly describes or teaches the subject matter alleged to be anticipated, the reference must provide enough information to permit an inference that the subject matter is inherent. *Ex parte Garvin*, 62 USPQ 2d 1680 (BPAI 2001). The surfactant of Chiang would inherently be capable of non-covalently adhering to said carbon nanotubes, and the aromatic group would inherently be capable of π–like stacking onto the surface of carbon nanotubes to no less an extent than that of the instant application since Chiang discloses the same dispersion as that of the instant application.

Accordingly, the burden shifts to Applicants to show that non-covalent adhesion and π–like stacking would not occur in the dispersion of Chiang.

13. With regard to **Claims 55-57**, Lobovsky discloses a composition of carbon nanotubes comprising an aqueous medium, carbon nanotubes, and a surfactant comprising a sodium alkyl sulphate with an alkyl group having from 8 to 30 carbon atoms, such as sodium dodecyl sulphate (Lobovsky, p. 3, 0024; p. 4, 0042; p. 5, 0050; "Example 1;" and Fig. 3). The difference between the composition of Lobovsky and that of **Claims 55-57** is Lobovsky does not disclose the claimed surfactant.

14. With regard to **Claims 55-57**, Chiang discloses a composition comprising fullerenes; and a surfactant comprising sodium dodecylbenzene sulfonate (Chiang, c. 10, Example 2). Chiang further disclose the composition in the form of a particle (Chiang, c. 10, Example 2). Thus, it would have been obvious to one of ordinary skill in the art to try to modify the composition disclosed by Lobovsky with the sodium dodecylbenzene sulfonate of Chiang because one of ordinary skill in the art could have pursued the known potential surfactant options within his or her technical grasp with a reasonable expectation of success.

15. While the aforementioned applied art does not explicitly disclose the surfactant being adsorbed to the exterior surface of said carbon nanotubes (**Claim 56**), this limitation would be inherent. For a reference which neither expressly describes or teaches the subject matter alleged to be anticipated, the reference must provide enough information to permit an inference that the subject matter is inherent. *Ex parte Garvin*, 62 USPQ 2d 1680 (BPAI 2001). The surfactant of Chiang would inherently be adsorbed

to the exterior surface of said carbon nanotubes to no less an extent than that of the instant application since Chiang discloses the same composition as that of the instant application. Accordingly, the burden shifts to Applicants to show that adsorption to the exterior surface of said carbon nanotubes would not occur in the composition of Chiang.

16. **Claims 19-30, 35, 36, 98 and 99** are rejected under 35 U.S.C. 103(a) as being unpatentable over Rohrbaugh et al. (US 2002/0028288 A1) or, alternatively, Lobovsky et al. (US 2002/0113335 A1) in view of Rohrbaugh et al. (US 2002/0028288 A1) as applied to **Claim 1** above, and further as discussed below.

17. Rohrbaugh does not disclose the concentration of dispersed carbon nanotubes being between about 0.001 mg/mL and about 500 mg/mL (**Claim 19**), at least 0.5 mg/mL (**Claim 20**), or at most 30 mg/mL (**Claim 21**); the single wall carbon nanotubes including individual single wall carbon nanotubes (**Claims 22-25 and 28**); the number percentage of individual SWNTs being at least 50 percent (**Claims 22, 27, and 98**), 75 percent (**Claim 23**), or 90 percent (**Claim 24**); the mean length of individual SWNTs being at least about 120 nm (**Claim 25**), 300 nm (**Claim 26**), or 500 nm (**Claims 28 and 99**); the weight ratio of carbon nanotubes to surfactant being in the range from about 5 : 1 to about 1 : 10 (**Claim 29**); the carbon nanotubes being charge stabilized (**Claim 30**); the aqueous liquid phase comprising at least about 50 wt% water (**Claim 35**); or the aqueous liquid phase comprising up to about 50 wt% of a solvent different than water (**Claim 36**).

18. With regard to **Claim 30**, the claimed limitation would be inherent. For a reference which neither expressly describes or teaches the subject matter alleged to be anticipated, the reference must provide enough information to permit an inference that the subject matter is inherent. *Ex parte Garvin*, 62 USPQ 2d 1680 (BPAI 2001). The nanotubes of Rohrbaugh would inherently be charge stabilized since there is no teaching otherwise. Accordingly, the burden shifts to Applicants to show that charge stabilized nanotubes would not be present in the composition of Rohrbaugh.

19. With regard to **Claims 19-21, 29, 35 and 36**, an expected component amount or ratio is a result effective variable since one of ordinary skill in the art would expect different properties in the product as such amount or ratio varies. Since the amount/ratio is a result effective variable, it is within the skill of one of ordinary skill in the art to develop a suitable dispersed carbon nanotube concentration, weight ratio of carbon nanotubes to surfactant, or solvent component amount. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

20. With regard to **Claims 22-24, 27 and 98**, an expected number percentage of individual SWNTs is a result effective variable since one of ordinary skill in the art would expect different properties in the product as such number percentage varies. Since the number percentage is a result effective variable, it is within the skill of one of ordinary skill in the art to develop a suitable number percentage of individual SWNTs. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

21. With regard to **Claims 25, 26, 28 and 99**, an expected mean length of single SWNTs is a result effective variable since one of ordinary skill in the art would expect

different properties in the product as such mean length varies. Since the mean length is a result effective variable, it is within the skill of one of ordinary skill in the art to develop a suitable mean length of single SWNTs. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

22. **Claims 19-30, 35, 36, 98 and 99** are rejected under 35 U.S.C. 103(a) as being unpatentable over Chiang (US 5,648,523) or, alternatively, Lobovsky et al. (US 2002/0113335 A1) in view of Chiang (US 5,648,523) as applied to **Claim 1** above, and further as discussed below.

23. Chiang does not disclose the concentration of dispersed carbon nanotubes being between about 0.001 mg/mL and about 500 mg/mL (**Claim 19**), at least 0.5 mg/mL (**Claim 20**), or at most 30 mg/mL (**Claim 21**); the single wall carbon nanotubes including individual single wall carbon nanotubes (**Claims 22-25 and 28**); the number percentage of individual SWNTs being at least 50 percent (**Claims 22, 27, and 98**), 75 percent (**Claim 23**), or 90 percent (**Claim 24**); the mean length of individual SWNTs being at least about 120 nm (**Claim 25**), 300 nm (**Claim 26**), or 500 nm (**Claims 28 and 99**); the weight ratio of carbon nanotubes to surfactant being in the range from about 5 : 1 to about 1 : 10 (**Claim 29**); the carbon nanotubes being charge stabilized (**Claim 30**); the aqueous liquid phase comprising at least about 50 wt% water (**Claim 35**); or the aqueous liquid phase comprising up to about 50 wt% of a solvent different than water (**Claim 36**).

24. With regard to **Claim 30**, the claimed limitation would be inherent. For a reference which neither expressly describes or teaches the subject matter alleged to be anticipated, the reference must provide enough information to permit an inference that the subject matter is inherent. *Ex parte Garvin*, 62 USPQ 2d 1680 (BPAI 2001). The fullerenes of Chiang would inherently be charge stabilized since there is no teaching otherwise. Accordingly, the burden shifts to Applicants to show that charge stabilized fullerenes would not be present in the composition of Chiang.

25. With regard to **Claims 19-21, 29, 35 and 36**, an expected component amount or ratio is a result effective variable since one of ordinary skill in the art would expect different properties in the product as such amount or ratio varies. Since the amount/ratio is a result effective variable, it is within the skill of one of ordinary skill in the art to develop a suitable dispersed carbon nanotube concentration, weight ratio of carbon nanotubes to surfactant, or solvent component amount. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

26. With regard to **Claims 22-24, 27 and 98**, an expected number percentage of individual SWNTs is a result effective variable since one of ordinary skill in the art would expect different properties in the product as such number percentage varies. Since the number percentage is a result effective variable, it is within the skill of one of ordinary skill in the art to develop a suitable number percentage of individual SWNTs. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

27. With regard to **Claims 25, 26, 28 and 99**, an expected mean length of single SWNTs is a result effective variable since one of ordinary skill in the art would expect

different properties in the product as such mean length varies. Since the mean length is a result effective variable, it is within the skill of one of ordinary skill in the art to develop a suitable mean length of single SWNTs. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

28. **Claims 14 and 31-34** are rejected under 35 U.S.C. 103(a) as being unpatentable over Rohrbaugh et al. (US 2002/0028288 A1) or, alternatively, Lobovsky et al. (US 2002/0113335 A1) in view of Rohrbaugh et al. (US 2002/0028288 A1) as applied to **Claim 1** above, and further in view of Wei et al. (US 6,899,947 B2).

29. Rohrbaugh does not disclose a plurality of alkyl groups being bonded to the aromatic group (**Claim 14**); said surfactant comprising at least two alkyl groups (**Claim 31**); said surfactant comprising at least two aromatic groups (**Claim 32**); said surfactant comprising at least two charged head groups (**Claim 33**); or said surfactant comprising at least two alkyl chains, at least two aromatic rings, at least two charged groups, or any combination thereof (**Claim 34**).

30. With regard to **Claims 14 and 31-34**, Wei discloses calixarene surfactants for dispersing nanoparticles (Wei, "Abstract;" c. 1, l. 48-60; c. 3, l. 38-67; c. 4, l. 1-9; Fig. 1A).

31. Thus, it would have been obvious to one of ordinary skill in the art to modify the dispersion of Rohrbaugh with the calixarene surfactants of Wei in order to obtain an inexpensive and robust dispersion (Wei, c. 3, l. 38-51).

32. **Claims 14 and 31-34** are rejected under 35 U.S.C. 103(a) as being unpatentable over Chiang (US 5,648,523) or, alternatively, Lobovsky et al. (US 2002/0113335 A1) in view of Chiang (US 5,648,523) as applied to **Claim 1** above, and further in view of Wei et al. (US 6,899,947 B2).

33. Chiang does not disclose a plurality of alkyl groups being bonded to the aromatic group (**Claim 14**); said surfactant comprising at least two alkyl groups (**Claim 31**); said surfactant comprising at least two aromatic groups (**Claim 32**); said surfactant comprising at least two charged head groups (**Claim 33**); or said surfactant comprising at least two alkyl chains, at least two aromatic rings, at least two charged groups, or any combination thereof (**Claim 34**).

34. With regard to **Claims 14 and 31-34**, Wei discloses calixarene surfactants for dispersing nanoparticles (Wei, "Abstract;" c. 1, l. 48-60; c. 3, l. 38-67; c. 4, l. 1-9; Fig. 1A).

35. Thus, it would have been obvious to one of ordinary skill in the art to modify the dispersion of Rohrbaugh with the calixarene surfactants of Wei in order to obtain an inexpensive and robust dispersion (Wei, c. 3, l. 38-51).

36. **Claims 37-52** are rejected under 35 U.S.C. 103(a) as being unpatentable over Lobovsky et al. (US 2002/0113335 A1) in view of Rohrbaugh et al. (US 2002/0028288 A1) or, alternatively, in view of Chiang (US 5,648,523).

37. With regard to **Claim 37**, Lobovsky discloses a method of preparing a dispersion of carbon nanotubes comprising mixing an aqueous medium, carbon nanotubes, and a

surfactant comprising a sodium alkyl sulphate with an alkyl group having from 8 to 30 carbon atoms, such as sodium dodecyl sulphate in a low-power, high-frequency bath sonicator (Lobovsky, p. 3, 0024; p. 4, 0042; p. 5, 0050; "Example 1;" and Fig. 3). The difference between the process of Lobovsky and that of **Claims 37 and 44** is Lobovsky does not disclose a surfactant comprising an aromatic group or an alkaline salt of a C_n alkyl benzene sulfonate, where n is between about 8 and about 16.

38. With regard to **Claims 37 and 44**, Rohrbaugh discloses a dispersion comprising an aqueous medium; nanotubes; and a surfactant comprising sodium dodecylbenzene sulfonate (Rohrbaugh, Abstract, 0044-0046; 0073-0130; 0141). Thus, it would have been obvious to one of ordinary skill in the art to modify the process of Lobovsky with the sodium dodecylbenzene sulfonate of Rohrbaugh because one of ordinary skill in the art could have pursued the known potential surfactant options within his or her technical grasp with a reasonable expectation of success.

39. With regard to **Claims 37 and 44**, Chiang discloses a dispersion comprising an aqueous medium; fullerenes; and a surfactant comprising sodium dodecylbenzene sulfonate (Chiang, c. 10, Example 2). Thus, it would have been obvious to one of ordinary skill in the art to modify the process of Lobovsky with the sodium dodecylbenzene sulfonate of Chiang because one of ordinary skill in the art could have pursued the known potential surfactant options within his or her technical grasp with a reasonable expectation of success.

40. With regard to **Claims 42 and 43**, Lobovsky discloses the bath sonicator having a power of 30 watts and a frequency of 20 kHz (Lobovsky, "Example 1").

41. Lobovsky does not disclose a mixing time in the bath sonicator being at least about 2 hours (**Claim 38**), 4 hours (**Claim 39**), 8 hours (**Claim 40**), or between about 16 and about 24 hours (**Claim 41**); the concentration of dispersed carbon nanotubes being between about 0.001 mg/mL and about 500 mg/mL (**Claim 45**) or at least 0.5 mg/mL (**Claim 46**); the mixing time being selected to give rise to at least about 50 number percent of the dispersed carbon nanotubes being individual SWNTs (**Claim 47**); the mixing time being selected to give rise to the mean length of individual SWNTs being at least about 300 nm (**Claim 48**) or 500 nm (**Claim 49**); the single wall carbon nanotubes including individual single wall carbon nanotubes (**Claim 49**); the weight ratio of carbon nanotubes to surfactant being in the range of from about 5 : 1 to about 1 : 10 (**Claim 50**); the concentration of surfactant being less than the critical micelle concentration (**Claim 51**); nor electronic properties of the dispersed carbon nanotubes being essentially the same as the electronic properties of the carbon nanotubes prior to mixing (**Claim 52**).

42. With regard to **Claim 49**, one of ordinary skill in the art would expect at least some individual single wall carbon nanotubes to be present in a dispersion comprising water, single wall carbon nanotubes and surfactant (sodium dodecyl benzene sulfonate).

43. With regard to **Claim 52**, the claimed limitation would be inherent. For a reference which neither expressly describes or teaches the subject matter alleged to be anticipated, the reference must provide enough information to permit an inference that the subject matter is inherent. *Ex parte Garvin*, 62 USPQ 2d 1680 (BPAI 2001). The

electronic properties of the dispersed carbon nanotubes of Lobovsky would inherently be essentially the same as the electronic properties of the carbon nanotubes prior to mixing since there is no teaching otherwise. Accordingly, the burden shifts to Applicants to show that the electronic properties of the dispersed carbon nanotubes would not be essentially the same as the electronic properties of the carbon nanotubes prior to mixing in the process of Lobovsky.

44. With regard to **Claims 45, 46, 50 and 51**, an expected component amount or ratio is a result effective variable since one of ordinary skill in the art would expect different properties in the product as such amount or ratio varies. Since the amount/ratio is a result effective variable, it is within the skill of one of ordinary skill in the art to develop a suitable dispersed carbon nanotube concentration, weight ratio of carbon nanotubes to surfactant, or surfactant concentration. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

45. With regard to **Claims 38-41 and 47-49**, expected mixing times, mean lengths of individual SWNTs, and number percentages of individual SWNTs are result effective variables since one of ordinary skill in the art would expect different properties in the product as such times, lengths, and number percentages vary. Since mixing times, mean lengths, and number percentages are result effective variables, it is within the skill of one of ordinary skill in the art to develop suitable mixing times and corresponding mean lengths and number percentages of individual SWNTs. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

46. **Claims 53 and 54** are rejected under 35 U.S.C. 103(a) as being unpatentable over Lobovsky et al. (US 2002/0113335 A1) in view of Rohrbaugh et al. (US 2002/0028288 A1) or, alternatively, in view of Chiang (US 5,648,523) as applied to **Claim 37** above, and further in view of Yamamoto et al. (*Journal of Physics D*).

47. The aforementioned applied art does not disclose a step of electrophoretically separating the dispersed carbon nanotubes (**Claim 53**) nor the carbon nanotubes being separated according to length, shape, or any combination thereof (**Claim 54**).

48. With regard to **Claims 53-54**, Yamamoto discloses electrophoretically separating dispersed carbon nanotubes according to length (Yamamoto, whole document).

49. Thus, it would have been obvious to one of ordinary skill in the art to modify the process of the prior art with the electrophoretic separation of Yamamoto because one of ordinary skill in the art could have pursued the known potential separation options within his or her technical grasp with a reasonable expectation of success.

50. **Claims 61-63, 69, 70, 72, 74-101, 103-109 and 124-126** are rejected under 35 U.S.C. 103(a) as being unpatentable over Glatkowski (US 2003/0122111 A1) in view of Rohrbaugh et al. (US 2002/0028288 A1) or, alternatively, in view of Chiang (US 5,648,523).

51. With regard to **Claims 61-63**, Glatkowski discloses a method of preparing a composite comprising dispersing carbon nanotubes and a surfactant in a hardenable matrix precursor; and hardening the precursor via curing (Glatkowski, p. 3, 0048; p. 4, 0054 and 0060-0061; p. 5, 0061; p. 6, 0082; Claims 13 and 72). The difference

between the process of Glatkowski and that of **Claims 61 and 69** is Glatkowski does not disclose said surfactant comprising an alkyl group having from about 4 to about 30 carbon atoms, about 6 to about 30 carbon atoms, or about 10 and about 14 carbon atoms, an aromatic group, and a head group.

52. With regard to **Claims 61 and 69**, Rohrbaugh discloses a dispersion comprising an aqueous medium; nanotubes; and a surfactant comprising sodium dodecylbenzene sulfonate (Rohrbaugh, Abstract, 0044-0046; 0073-0130; 0141). Thus, it would have been obvious to one of ordinary skill in the art to modify the product and process of Glatkowski with the sodium dodecylbenzene sulfonate of Rohrbaugh because one of ordinary skill in the art could have pursued the known potential surfactant options within his or her technical grasp with a reasonable expectation of success.

53. With regard to **Claims 61 and 69**, Chiang discloses a dispersion comprising an aqueous medium; fullerenes; and a surfactant comprising sodium dodecylbenzene sulfonate (Chiang, c. 10, Example 2). Thus, it would have been obvious to one of ordinary skill in the art to modify the product and process of Glatkowski with the sodium dodecylbenzene sulfonate of Chiang because one of ordinary skill in the art could have pursued the known potential surfactant options within his or her technical grasp with a reasonable expectation of success.

54. With regard to **Claim 63**, Glatkowski discloses thermoplastics as possible polymers used (Glatkowski, p. 3, 0048).

55. With regard to **Claim 69**, Glatkowski discloses a solid media comprising a substrate, said substrate comprising carbon nanotubes (Glatkowski, p. 1, 0015; p. 3-4,

0049; Claims 22 and 35) and a surfactant (Glatkowski, p. 4-5; 0061; Claim 72) adsorbed thereon (Glatkowski, p. 11, 0131).

56. With regard to **Claim 74**, Glatkowski discloses a method of preparing a nematic nanotube gel comprising providing a dispersion comprising carbon nanotubes, solvent, gel precursor, and a surfactant; gelling at least a portion of said gel precursor to form a gel; and subjecting the gel to an orienting field giving rise to a nematic orientation of the carbon nanotubes (Glatkowski, p. 1, 0015; p. 3, 0048-0049; p. 4, 0049, 0051, 0053-0054, 0057-0058, and 0060-0061; p. 5, 0061; p. 6, 0082; Claims 13 and 72). The difference between the process of Glatkowski and that of **Claims 74, 77-79 and 81-89** is Glatkowski does not disclose said surfactant comprising an alkyl group having from about 4 to about 30 carbon atoms, about 6 to about 30 carbon atoms, or about 10 and about 14 carbon atoms, an aromatic group, and a head group; the aromatic group comprising at least one carbocyclic aromatic ring, heterocyclic aromatic ring, or any combination thereof; said aromatic group comprising at least one benzene ring; said charged head group comprising a sulfate group, sulfonate group, amine group, ammonium group, or any combination thereof; said surfactant comprising said alkyl group bonded to the aromatic group, said aromatic group being further bonded to the head group; said alkyl group having between about 8 and about 16 carbon atoms, and said charged head group comprising sulfonate; said surfactant comprising an alkaline salt of a C_n alkyl benzene sulfonate, where n is between about 8 and about 16; said alkaline salt comprising at least one counterion selected from the Group IA elements; said counterion being sodium, potassium, or any combination thereof; nor said

surfactant comprising sodium hexylbenzene sulfonate, sodium octylbenzene sulfonate, sodium dodecylbenzene sulfonate, sodium hexadecylbenzene sulfonate, or any combination thereof.

57. With regard to **Claims 74, 77-79 and 81-89**, Rohrbaugh discloses a dispersion comprising an aqueous medium; nanotubes; and a surfactant comprising sodium dodecylbenzene sulfonate (Rohrbaugh, Abstract, 0044-0046; 0073-0130; 0141). Thus, it would have been obvious to one of ordinary skill in the art to modify the product of Glatkowski with the sodium dodecylbenzene sulfonate of Rohrbaugh because one of ordinary skill in the art could have pursued the known potential surfactant options within his or her technical grasp with a reasonable expectation of success.

58. With regard to **Claims 74, 77-79 and 81-89**, Chiang discloses a dispersion comprising an aqueous medium; fullerenes; and a surfactant comprising sodium dodecylbenzene sulfonate (Chiang, c. 10, Example 2). Thus, it would have been obvious to one of ordinary skill in the art to modify the product of Glatkowski with the sodium dodecylbenzene sulfonate of Chiang because one of ordinary skill in the art could have pursued the known potential surfactant options within his or her technical grasp with a reasonable expectation of success.

59. With regard to **Claim 75**, Glatkowski discloses an orienting field comprising a pressure field (Glatkowski, p. 4, 0057).

60. With regard to **Claim 76**, Glatkowski discloses the carbon nanotubes being single-wall or multi-wall carbon nanotubes (Glatkowski, Claim 63).

61. With regard to **Claim 105**, Glatkowski discloses the gel precursor comprising polymers or monomers (Glatkowski, p. 3, 0048).

62. With regard to **Claims 106-108**, Glatkowski discloses a styrenic monomer (Glatkowski, p. 3, 0048).

63. With regard to **Claim 109**, Glatkowski discloses the polymer gel precursor further comprising a crosslinker (Glatkowski, p. 4, 0060).

64. With regard to **Claim 124**, Glatkowski discloses the step of micro-phase separating the dispersion into nanotube rich/gel poor and nanotube poor/gel rich phases (Glatkowski, p. 4, 0054).

65. With regard to **Claim 125**, Glatkowski discloses the gel being a polymer gel (Glatkowski, p. 3, 0048; p. 4, 0051).

66. With regard to **Claim 126**, Glatkowski discloses the field being a pressure field giving rise to transport of at least a portion of the solvent out of the gel (Glatkowski, p. 4, 0049 and 0057).

67. Glatkowski does not disclose curing the precursor with light, heat, radiation, or time (**Claim 62**); the hardenable matrix precursor being a polymer capable of solidifying upon cooling to a temperature being lower than its glass transition temperature, its crystalline melt transition, its order-disorder transition temperature, or any combination thereof (**Claim 63**); the substrate capable of receiving chemical, biological, or both chemical and biological compounds for detection (**Claim 69**); the surfactant being adsorbed to the exterior surface of the carbon nanotubes (**Claim 70**); the carbon nanotubes being capable of adsorbing protons to give rise to a detectable signal (**Claim**

72); the surfactant being adsorbed to the carbon nanotubes (**Claim 77**); the aromatic group being capable of π–like stacking onto the surface of carbon nanotubes (**Claim 80**); the concentration of dispersed carbon nanotubes being between about 0.001 mg/mL and about 500 mg/mL (**Claim 90**), at least 0.5 mg/mL (**Claim 91**), or at most 30 mg/mL (**Claim 92**); the number percentage of individual SWNTs being at least 50 percent (**Claim 93**), 75 percent (**Claim 94**), or 90 percent (**Claim 95**); the single wall carbon nanotubes including individual single wall carbon nanotubes (**Claims 93-97**); the mean length of individual SWNTs being at least about 120 nm (**Claim 96**) or 300 nm (**Claim 97**); the weight ratio of carbon nanotubes to surfactant being in the range from about 5 : 1 to about 1 : 10 (**Claim 100**); the carbon nanotubes being charge stabilized (**Claim 101**); the solvent comprising at least about 50 wt% water (**Claim 103**); the solvent comprising up to about 50 wt% of a solvent different than water (**Claim 104**); or the micro-phase separating step being carried out under conditions giving rise to polymerization-induced phase separation (**Claim 125**).

68. With regard to **Claim 62**, light, heat, radiation, and time are all well-known curing approaches in the art.

69. With regard to **Claim 63**, it is well-known in the art that thermoplastics solidify upon cooling to a temperature lower than the specific plastic's glass transition temperature.

70. With regard to **Claim 70**, while the aforementioned applied art does not explicitly disclose the surfactant being adsorbed to the exterior surface of said carbon nanotubes,

it is well-known in the art that surfactants adsorb to the exterior surface of carbon nanotubes.

71. With regard to **Claim 72**, while the aforementioned applied art does not explicitly disclose the carbon nanotubes being capable of adsorbing protons to give rise to a detectable signal, it is well-known in the art that carbon nanotubes are capable of adsorbing protons and thus give rise to detectable signals.

72. With regard to **Claim 80**, although Glatkowski does not explicitly disclose the aromatic group being capable of π–like stacking onto the surface of carbon nanotubes, this claimed limitation would be inherent. For a reference which neither expressly describes or teaches the subject matter alleged to be anticipated, the reference must provide enough information to permit an inference that the subject matter is inherent. *Ex parte Garvin*, 62 USPQ 2d 1680 (BPAI 2001). The surfactant of Rohrbaugh or Chiang would inherently be capable of π–like stacking onto the surface of carbon nanotubes to no less an extent than that of the instant application since Rohrbaugh and Chiang disclose the same surfactants as that of the instant application. Accordingly, the burden shifts to Applicants to show that π–like stacking would not occur in the dispersion of the aforementioned applied art.

73. With regard to **Claim 101**, the claimed limitation would be inherent. For a reference which neither expressly describes or teaches the subject matter alleged to be anticipated, the reference must provide enough information to permit an inference that the subject matter is inherent. *Ex parte Garvin*, 62 USPQ 2d 1680 (BPAI 2001). The carbon nanotubes of the aforementioned applied art would inherently be charge

stabilized in the dispersion since there is no teaching otherwise. Accordingly, the burden shifts to Applicants to show that charge stabilization would not occur in the dispersion of the aforementioned applied art.

74. With regard to **Claims 90-92, 100, 103 and 104**, an expected component amount or ratio is a result effective variable since one of ordinary skill in the art would expect different properties in the product as such amount or ratio varies. Since the amount/ratio is a result effective variable, it is within the skill of one of ordinary skill in the art to develop a suitable dispersed carbon nanotube concentration, weight ratio of carbon nanotubes to surfactant, or solvent component amount. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

75. With regard to **Claims 93-95**, an expected number percentage of single SWNTs is a result effective variable since one of ordinary skill in the art would expect different properties in the product as such number percentage varies. Since the number percentage is a result effective variable, it is within the skill of one of ordinary skill in the art to develop a suitable number percentage of single SWNTs. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

76. With regard to **Claims 93-97**, one of ordinary skill in the art would expect at least some individual single wall carbon nanotubes to be present in a dispersion comprising water, single wall carbon nanotubes and surfactant (sodium dodecyl benzene sulfonate).

77. With regard to **Claims 96 and 97,** an expected mean length of single SWNTs is a result effective variable since one of ordinary skill in the art would expect different

properties in the product as such mean length varies. Since the mean length is a result effective variable, it is within the skill of one of ordinary skill in the art to develop a suitable mean length of single SWNTs. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

78. With regard to **Claim 125**, it would have been obvious to one of ordinary skill in the art that in order to carry out the micro-phase separating step, the step would need to be carried out under conditions giving rise to polymerization-induced phase separation.

79. **Claims 64-68** are rejected under 35 U.S.C. 103(a) as being unpatentable over Glatkowski (US 2003/0122111 A1) in view of Rohrbaugh et al. (US 2002/0028288 A1) or, alternatively, in view of Chiang (US 5,648,523) and Wei et al. (US 6,899,947 B2).

80. With regard to **Claim 64**, Glatkowski discloses an assembly comprising a substrate; and carbon nanotubes (Glatkowski, p. 1, 0015; p. 3-4, 0049; Claims 22 and 35) and a surfactant (Glatkowski, p. 4-5; 0061; Claim 72) adjacent to said substrate (Glatkowski, p. 11, 0131). The difference between the product of Glatkowski and that of **Claim 64** is Glatkowski does not disclose said surfactant comprising an alkyl group having from about 4 to about 30 carbon atoms, an aromatic group, and a head group.

81. With regard to **Claim 64**, Rohrbaugh discloses a dispersion comprising an aqueous medium; nanotubes; and a surfactant comprising sodium dodecylbenzene sulfonate (Rohrbaugh, Abstract, 0044-0046; 0073-0130; 0141). Thus, it would have been obvious to one of ordinary skill in the art to modify the product of Glatkowski with the sodium dodecylbenzene sulfonate of Rohrbaugh because one of ordinary skill in the

art could have pursued the known potential surfactant options within his or her technical grasp with a reasonable expectation of success.

82. With regard to **Claim 64**, Chiang discloses a dispersion comprising an aqueous medium; fullerenes; and a surfactant comprising sodium dodecylbenzene sulfonate (Chiang, c. 10, Example 2). Thus, it would have been obvious to one of ordinary skill in the art to modify the product of Glatkowski with the sodium dodecylbenzene sulfonate of Chiang because one of ordinary skill in the art could have pursued the known potential surfactant options within his or her technical grasp with a reasonable expectation of success.

83. With regard to **Claim 67**, Glatkowski discloses a method of assembling carbon nanotubes comprising contacting a dispersion comprising an aqueous medium, carbon nanotubes and a surfactant (Glatkowski, p. 1, 0015; p. 3-4, 0049; p. 4-5; 0061; p. 11, 0131; Claims 22, 35, and 72). The difference between the process of Glatkowski and that of **Claim 67** is Glatkowski does not disclose said surfactant comprising an alkyl group having from about 4 to about 30 carbon atoms, an aromatic group, and a head group.

84. With regard to **Claim 67**, Rohrbaugh discloses a dispersion comprising an aqueous medium; nanotubes; and a surfactant comprising sodium dodecylbenzene sulfonate (Rohrbaugh, Abstract, 0044-0046; 0073-0130; 0141). Thus, it would have been obvious to one of ordinary skill in the art to modify the process of Glatkowski with the sodium dodecylbenzene sulfonate of Rohrbaugh because one of ordinary skill in the

art could have pursued the known potential surfactant options within his or her technical grasp with a reasonable expectation of success.

85. With regard to **Claim 67**, Chiang discloses a dispersion comprising an aqueous medium; fullerenes; and a surfactant comprising sodium dodecylbenzene sulfonate (Chiang, c. 10, Example 2). Thus, it would have been obvious to one of ordinary skill in the art to modify the process of Glatkowski with the sodium dodecylbenzene sulfonate of Chiang because one of ordinary skill in the art could have pursued the known potential surfactant options within his or her technical grasp with a reasonable expectation of success.

86. Glatkowski does not disclose the carbon nanotubes being self-assembled on the substrate (**Claims 65 and 68**); nor the surfactant being adsorbed to the exterior surface of the carbon nanotubes (**Claim 66**).

87. With regard to **Claims 65 and 68**, Wei discloses self-assembly of nanoparticles as one of the key methodologies in materials synthesis (Wei, c. 1, l. 16-29; Claim 4). Thus, it would have been obvious to one of ordinary skill in the art to modify the product and process of the aforementioned applied art with the self-assembly of Wei in order to obtain a process capable of producing a product with possible use in optical/infrared scattering, radiation shielding, or sensing (Wei, c. 1, l. 16-29).

88. With regard to **Claim 66**, while the aforementioned applied art does not explicitly disclose the surfactant being adsorbed to the exterior surface of said carbon nanotubes, it is well-known in the art that surfactants adsorb to the exterior surface of carbon nanotubes.

89. **Claims 71 and 102** are rejected under 35 U.S.C. 103(a) as being unpatentable over Glatkowski (US 2003/0122111 A1) in view of Rohrbaugh et al. (US 2002/0028288 A1) or, alternatively, in view of Chiang (US 5,648,523) as applied to **Claims 69 and 74** above, and further in view of Wei et al. (US 6,899,947 B2).

90. The aforementioned applied art does not disclose the carbon nanotubes being self-assembled on the substrate (**Claim 71**); nor said surfactant comprising at least two alkyl chain tails (**Claim 102**).

91. With regard to **Claim 71**, Wei discloses self-assembly of nanoparticles as one of the key methodologies in materials synthesis (Wei, c. 1, l. 16-29; Claim 4). Thus, it would have been obvious to one of ordinary skill in the art to modify the product of the aforementioned applied art with the self-assembly of Wei in order to obtain a process capable of producing a product with possible use in optical/infrared scattering, radiation shielding, or sensing (Wei, c. 1, l. 16-29).

92. With regard to **Claim 102**, Wei discloses calixarene surfactants for dispersing nanoparticles (Wei, "Abstract;" c. 1, l. 48-60; c. 3, l. 38-67; c. 4, l. 1-9; Fig. 1A).

93. Thus, it would have been obvious to one of ordinary skill in the art to modify the process of the aforementioned applied art with the calixarene surfactants of Wei in order to obtain a process utilizing an inexpensive and robust dispersion (Wei, c. 3, l. 38-51).

94. **Claim 73** is rejected under 35 U.S.C. 103(a) as being unpatentable over Glatkowski (US 2003/0122111 A1) in view of Rohrbaugh et al. (US 2002/0028288 A1)

or, alternatively, in view of Chiang (US 5,648,523) as applied to **Claim 69** above, and further in view of Cho et al. (US 7,013,708 B1).

95. The aforementioned applied art does not disclose the carbon nanotubes being chemically functionalized to adsorb specific biological or chemical substances to give rise to a detectable signal (**Claim 73**).

96. With regard to **Claim 73**, Cho discloses chemically functionalizing carbon nanotubes to adsorb specific biological or chemical substances to give rise to a detectable signal (Cho, c. 1, l. 22-32; c. 3, l. 38-45; c. 7, l. 30-33; and c. 8, l. 31-37). Thus, it would have been obvious to one of ordinary skill in the art to modify the product of the aforementioned applied art with the functionalized carbon nanotubes of Cho because one of ordinary skill in the art could have pursued the known potential sensing options within his or her technical grasp with a reasonable expectation of success.

97. **Claims 110 and 111** are rejected under 35 U.S.C. 103(a) as being unpatentable over Glatkowski (US 2003/0122111 A1) in view of Rohrbaugh et al. (US 2002/0028288 A1) or, alternatively, in view of Chiang (US 5,648,523) as applied to **Claim 105** above, and further in view of Pienkowski et al. (US 2002/0001620 A1).

98. The aforementioned applied art does not disclose an initiator (**Claim 110**) or an accelerator (**Claim 111**).

99. With regard to **Claims 110-111**, Pienkowski discloses a method of producing a resin comprising carbon nanotubes dispersed in a polymethylmethacrylate matrix,

wherein the polymer gel precursor further comprises an initiator and an accelerator (Pienkowski, 0006; 0019).

100. Thus, it would have been obvious to one of ordinary skill in the art to modify the process of the aforementioned applied art with the initiator and accelerator of Pienkowski because one of ordinary skill in the art could have pursued the known potential options for maximizing process efficiency within his or her technical grasp with a reasonable expectation of success.

101. **Claims 112-122** are rejected under 35 U.S.C. 103(a) as being unpatentable over Glatkowski (US 2003/0122111 A1) in view of Rohrbaugh et al. (US 2002/0028288 A1) or, alternatively, in view of Chiang (US 5,648,523) as applied to **Clam 75** above, and further in view of Ilmain (*Nature*).

102. The aforementioned applied art does not disclose a thermodynamic field giving rise to a volumetric phase transition (**Claim 112**); the volumetric phase transition arising from a change in temperature (**Claim 113**), an increase in temperature (**Claim 114**), or an incompatibility between the gel and the solvent (**Claim 115**); the incompatibility between the gel and the solvent arising from a decrease in a specific attractive interaction (**Claim 116**), wherein the specific attractive interaction is hydrogen bonding (**Claim 117**); the gel being a polymer gel comprising a network, and the volumetric phase transition arising upon increasing temperature, wherein the polymer network becomes hydrophobic and the solvent is expelled from the gel (**Claim 118**); the solvent comprising at least about 50 weight percent water (**Claim 119**); the

ratio of the volume of the gel before the volumetric phase transition to the volume of the gel after the volumetric phase transition being in the range of from about 1.1 : I to about 50 : 1 (**Claim 121**); nor the ratio being in the range of from about 4:1 to about 30:1 (**Claim 122**).

103. With regard to **Claims 112-114**, Ilmain discloses thermodynamic fields giving rise to volumetric phase transitions in gels, the volumetric phase transitions arising from an increase in temperature (Ilmain, Abstract).

104. With regard to **Claims 115-117**, Ilmain discloses a volumetric phase transition arising from an incompatibility between a gel and a solvent, wherein the incompatibility between the gel and the solvent arises from a decrease in hydrogen bonding (Ilmain, p. 401).

105. With regard to **Claim 118**, Ilmain discloses a gel being a polymer gel comprising a network, and a volumetric phase transition arising upon increasing temperature, wherein the polymer network becomes hydrophobic and the solvent is expelled from the gel (Ilmain, p. 400-401).

106. Thus, it would have been obvious to one of ordinary skill in the art to modify the process of the aforementioned applied art with the volumetric phase transitions of Ilmain because one of ordinary skill in the art could have pursued the known potential options for gel manipulation within his or her technical grasp with a reasonable expectation of success.

107. With regard to **Claim 119**, an expected component amount is a result effective variable since one of ordinary skill in the art would expect different properties in the

product as such amount varies. Since the amount is a result effective variable, it is within the skill of one of ordinary skill in the art to develop a suitable solvent component amount. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

108. With regard to **Claims 121 and 122**, an expected volume ratio associated with a volumetric phase transition is a result effective variable since one of ordinary skill in the art would expect different properties in the product as such ratio varies. Since the volume ratio is a result effective variable, it is within the skill of one of ordinary skill in the art to develop a suitable ratio of the volume of the gel before the volumetric phase transition to the volume of the gel after the volumetric phase transition. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

109. **Claim 123** is rejected under 35 U.S.C. 103(a) as being unpatentable over Glatkowski (US 2003/0122111 A1) in view of Rohrbaugh et al. (US 2002/0028288 A1) or, alternatively, in view of Chiang (US 5,648,523) as applied to **Claim 74** above, and further in view of de Heer et al. (*Science*).

110. The aforementioned applied art does not disclose the gel becoming birefringent subsequent to subjecting said gel to the orienting field (**Claim 123**).

111. With regard to **Claim 123**, de Heer discloses an aligned carbon nanotube film becoming birefringent subsequent to subjecting said film to an orienting field (de Heer, p. 845-846).

112. Thus, it would have been obvious to one of ordinary skill in the art to modify the process of the aforementioned applied art with the birefringence of de Heer in order to

obtain a process capable of producing a nanotube gel with possible applications in various optical technologies.

113. **Claims 127-133** are rejected under 35 U.S.C. 103(a) as being unpatentable over Glatkowski (US 2003/0122111 A1) in view of Rohrbaugh et al. (US 2002/0028288 A1) or, alternatively, in view of Chiang (US 5,648,523) as applied to **Claim 126** above, and further in view of Shambaugh (US 7,001,556 B1).

114. The aforementioned applied art does not disclose the gel being confined to a restricted geometry vessel (**Claim 127**); the gel being confined to a capillary tube during transport of at least a portion of the solvent out of the gel (**Claim 128**); the gel being confined to a capillary tube after transport of at least a portion of the solvent out of the gel (**Claim 129**); the gel being confined to a capillary tube both during and after transport of at least a portion of the solvent out of the gel (**Claim 130**); the gel being confined to a capillary tube (**Claim 131**); the pressure field being lower than the partial pressure of the solvent in the vapor phase (**Claim 132**); nor the pressure field being an applied vacuum (**Claim 133**).

115. With regard to **Claims 127-133**, Shambaugh discloses a method for producing carbon nanotube/matrix composite materials with anisotropic structure, wherein a composite mixture is passes through a capillary and shear attenuation pressure is applied to the composite, either as the composite passes through the capillary, and/or after the composite passes through the capillary (Shambaugh, c. 2, l. 43-67). Shambaugh further discloses solvent material being removed from the

nanotube/solvent/matrix mixture to form a nanotube/matrix composite via atmospheric pressure and/or reduced pressure (vacuum) in a manner well-known in the art (Shambaugh, c. 5, l. 45-57).

116. Thus, it would have been obvious to one of ordinary skill in the art to modify the process of the aforementioned applied art with the capillary tube of Shambaugh because one of ordinary skill in the art could have pursued the known potential options for nanotube orientation within a gel via pressure within his or her technical grasp with a reasonable expectation of success.

117. **Claims 134-136** are rejected under 35 U.S.C. 103(a) as being unpatentable over Glatkowski (US 2003/0122111 A1) in view of Rohrbaugh et al. (US 2002/0028288 A1) or, alternatively, in view of Chiang (US 5,648,523) as applied to **Claim 75** above, and further in view of Smith et al. (*Applied Physics Letters*).

118. The aforementioned applied art does not disclose the field being a magnetic field having a strength between about 0.01 Tesla and about 60 Tesla (**Claim 134**); the viscosity of the gel while the dispersion is being subjected to the magnetic field being in the range of from about 1 centipoise to about 5000 centipoise (**Claim 135**); or the concentration of the carbon nanotubes being in the range of from about 0.01 mg/ml to about 500 mg/ml (**Claim 136**).

119. With regard to **Claim 134**, Smith discloses carbon nanotube alignment in films using a 25 Tesla strong magnetic field (Smith, p. 663).

120. Thus, it would have been obvious to one of ordinary skill in the art to modify the process of the aforementioned applied art with the magnetic field of Smith because one of ordinary skill in the art could have pursued the known potential options for nanotube orientation within his or her technical grasp with a reasonable expectation of success.

121. With regard to **Claim 135**, an expected viscosity is a result effective variable since one of ordinary skill in the art would expect different properties in the gel as such property varies. Since the viscosity is a result effective variable, it is within the skill of one of ordinary skill in the art to develop a suitable gel viscosity. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

122. With regard to **Claim 136**, an expected component concentration is a result effective variable since one of ordinary skill in the art would expect different properties in the product as such concentration varies. Since the component concentration is a result effective variable, it is within the skill of one of ordinary skill in the art to develop a suitable carbon nanotube concentration. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

123. **Claims 137 and 138** are rejected under 35 U.S.C. 103(a) as being unpatentable over Glatkowski (US 2003/0122111 A1) in view of Rohrbaugh et al. (US 2002/0028288 A1) or, alternatively, in view of Chiang (US 5,648,523) as applied to **Claim 74** above, and further in view of Barrera et al. (WO 01/92381 A1).

124. With regard to **Claim 138**, Glatkowski discloses the step of removing solvent from the gel (Glatkowski, p. 3-4, 0049).

125. The aforementioned applied art does not disclose at least a portion of the carbon nanotubes aligned end-on-end giving rise to a carbon nanotube needle (**Claim 137**).

126. With regard to **Claim 137**, Barrera discloses end-to-end nanotube contact being necessary for conduction in carbon nanotube gels (Barrera, p. 14, l. 18-22).

127. Thus, it would have been obvious to one of ordinary skill in the art to modify the process of the aforementioned applied art with the end-to-end alignment of Barrera in order to obtain a carbon nanotube gel capable of conductance.

Additional Prior Art

It is noted that the Smalley (US 2003/0133865 A1) reference from the previous Office action has a corresponding U.S. patent, US 7,288,238 B2. The Smalley (US 2003/0133865 A1) reference also has a copending application (US 2003/0170166 A1) filed July 2, 2002, that could have been applied exactly as US 2003/0133865 A1 was applied in the previous Office action. US 2003/0170166 A1 discloses a dispersion comprising an aqueous medium; single-wall carbon nanotubes; and a surfactant comprising sodium dodecylbenzene sulfonate (0010), substantially as in the instant application. US 2003/0170166 A1 also has a corresponding U.S. patent, US 7,125,502 B2.

It is noted that rejections very similar to that using the Rohrbaugh et al. (US 2002/0028288 A1) reference above could also be made in view of Rohrbaugh et al. (US 2002/0045010 A1), Ghosh et al. (US 2002/0172773 A1), Rohrbaugh et al. (US 2002/0176982 A1), and McDonald et al. (US 6,872,444 B2).

Response to 37 CFR 1.131 Declaration

The declaration filed on January 25, 2010, under 37 CFR 1.131 is sufficient to overcome the Smalley (US 2003/0133865 A1) rejection. The provisional applications from which Smalley claims priority (60/303,469, filed July 6, 2001; 60/303,470, filed July 6, 2001; 60/337,561, filed November 8, 2001; and 60/337,951, filed December 7, 2001) have been considered and they do not provide support for or a reduction to practice of a dispersion comprising: an aqueous medium; carbon nanotubes; and at least one surfactant comprising an aromatic group, an alkyl group having from about 4 to about 30 carbon atoms, and a charged head group. Thus, the effective filing date of the Smalley (US 2003/0133865 A1) reference with regard to the claimed surfactant is the filing date of the nonprovisional application, July 2, 2002. Applicants' declaration filed on January 25, 2010, under 37 CFR 1.131 shows a reduction to practice of the claimed dispersion prior to July 2, 2002. In particular, in Exhibit B of the declaration filed on January 25, 2010, under 37 CFR 1.131, Applicants show a reduction to practice of a dispersion comprising: an aqueous medium; carbon nanotubes (HiPCO); and at least one surfactant comprising an aromatic group, an alkyl group having from about 4 to about 30 carbon atoms, and a charged head group (NaDDBS) on May 22, 2002.

Response to Arguments

128. Applicants' arguments filed January 25, 2010, with respect to the Smalley (US 2003/0133865 A1) reference have been fully considered and are persuasive in view of

the declaration filed on January 25, 2010, under 37 CFR 1.131 and the aforementioned lack of support and reduction to practice in the Smalley provisional applications for the claimed surfactant. Therefore, the rejections over the Smalley (US 2003/0133865 A1) reference have been withdrawn. However, upon further consideration, new grounds of rejection are made, as can be seen above.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to BRITTANY M. MARTINEZ whose telephone number is (571) 270-3586. The examiner can normally be reached on Monday-Friday 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stanley Silverman can be reached on (571) 272-1358. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

BMM
/Brittany M Martinez/
Examiner, Art Unit 1793